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NEW POTAMOGETON RECORDS IN NEW HAMPSHIRE¹

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DURING the past five or six seasons probably some two or three times as many collections of pondweeds have been made in New Hampshire as had been accumulated in all previous time. Chiefly responsible for this contemporary surge of activity has been the New Hampshire State Fish and Game Department which for several years has been conducting the "Waterway Improvement Survey for Waterfowl" under the direction of Mr. Hilbert Siegler. Early in their study which necessarily included observations on the kinds and quantities of available aquatic plants the technical workers made contact with the late Rev. Hubert J. Sheehan O. S. B. of St. Anselm's College in Manchester and also with the senior author of this paper.

By far the greater part of the specimens collected during the work were taken by Stanley B. Krochmal one of the present authors but valuable collections were made from time to time by others on the "survey." Although other groups of aquatic plants were collected, the genus *Potamogeton* became the real lure, so much so indeed that it is said to have become finally a topic of breakfast conversation. It should further be mentioned that several years ago, Dr. Maurice Provost discovered some very significant stations for pondweeds, and other aquatics as well, in connection with earlier Fish and Game Department studies.

Collections made by those mentioned above are now to be

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found variously distributed in four herbaria, namely, the State Fish and Game Department collection in Concord, Krochmal's private herbarium, and those of the University of New Hampshire and of St. Anselm's College. During the early autumn of 1950 two of the present authors (Giguere and Riel) as part of the work in a graduate course in botany at the University of New Hampshire, elected to identify or verify, as well as record and map, all of the available relevant herbarium material, to record and map all reports in the literature, and finally to observe and collect as much field material as the lateness of season would permit. Their efforts were rewarded somewhat beyond anticipation by the discovery of some new stations for *Potamogeton confervoides* in the vicinity of Durham.

This paper is based upon two principal sources of information in addition to the recent collections: (1) gleanings from the Monographic Studies of St. John,⁴ Fernald⁵ and Ogden⁶ for records from New Hampshire, (2) inspection of exsiccatae in the following herbaria in addition to that of the University of New Hampshire, the Jesup Herbarium at Dartmouth, the St. Anselm's College Herbarium in Manchester, the Gray Herbarium, and the New England Botanical Club Herbarium. In addition, full attention has been given to recent literature and in particular to "local floras," only a few of which, of course, deal much with such obscure plants as pondweeds.

The authors wish to thank the curators of the several herbaria mentioned above for permitting the use of their specimens.

Of the nine species and varieties of *Potamogeton* to be discussed here, only one seems previously to have been entirely unreported from New Hampshire. However, the other eight have been collected, before this, only from one or at most a few often well known and publicized stations or else, if more abundant, have been known earlier only from one geographical section of the state such as the Connecticut Valley. It is apparent then that these additional stations represent in all cases significant expansions of the known ranges in New Hampshire.

P. PECTINATUS L.—So characteristic is this species, once its diversity of form is properly recognized, that it is surprising only

⁴ RHODORA, XVIII. 121-138 (1916).

⁵ Mem. Am. Acad. Arts and Sci. XVIII. pt. 1 (1932).

⁶ RHODORA, XIV 57-105, 119-163 and 171-214 (1943).

two stations for it in New Hampshire are well known. The Jesup collection from the Connecticut River at Hanover is both abundantly distributed among herbaria and adequately reported in the literature. The 1886 collection of it by Walter Deane in a "brackish pond," Rye, apparently was not known to St. John, loc. cit., who cited only the Hanover station. In July 1948 specimens of undoubted *P. pectinatus* (not in fruit) but growing in considerable abundance were collected by Hodgdon, Richards, and Leighton in shallow water near the New Hampshire shore of the Connecticut River in the towns of Claremont and Charlestown, Sullivan County. Later in the summer, collections were made by Krochmal in Orford and Piermont, Grafton County, also from the Connecticut River. What is most surprising and certainly warrants more investigation is its appearance in Paugus Bay, Laconia, Belknap County, where it was collected by Krochmal in September, 1948. These recent collections of *P. pectinatus* are all somewhat unusual as to leaf-shape although they all possess the fundamental diagnostic characteristic of "straight cross partitions." Indeed they closely match descriptions and authentic herbarium-specimens except that the leaves are mostly broader than 1 mm., in their wider parts, and actually appear to be hardly "setaceous" or "bristle-like." (Phrases in quotation marks are from standard descriptions.) The statement by St. John, loc. cit., p. 124 commenting on the leaves "(those of the first year's shoot often broader and blunt)" should possibly receive wider circulation if our difficulties in identifying purely vegetative specimens are any indication of the problems others may encounter.

P. CONFERVOIDES Reichenb. For some time the classical stations for *P. confervoides* in New Hampshire were Ethan's Pond (Willey Pond) on Mt. Willey, Lonesome Lake in Lincoln, Crawford Trout Pond and the present Saco Lake. Other localities near by where it was collected by Robbins, Oakes or Tuckerman apparently are not now known with certainty. Pease collected it many years ago in Dream Lake, Shelburne and Little Cherry Pond, Jefferson. In Maine *P. confervoides* was taken in 1891 by Fernald from Round Pond, Berwick at nearly sea-level and later was reliably reported from Mt. Katahdin. A much more recently discovered station is Newbert Pond, Appleton in Knox

County. Similarly in Massachusetts, while not common, the species again is found in acid-ponds (probably) at low elevations in Tewksbury, New Bedford, Dartmouth, and Uxbridge with a station at much higher altitude in Berkshire County. Considering its apparent great rarity in Maine and the four or five reported stations in much botanized eastern Massachusetts it comes as something of a surprise to find it appearing in ten different ponds in eight townships in southern New Hampshire. A report of *P. Tuckermanni* Robbins from Claremont by Jesup⁷ (at present unverified) may prove to be *P. confervoides*. A considerable number of stations occur, therefore, in the southern quarter or third of the state and none apparently between there and Albany, a distance of about fifty miles. These several new stations are as follows: Sullivan Co., Washington, Frog Pond, July 1, 1947, *E. Gould*, and North Pond, June 30, 1947, *E. Gould*; Cheshire Co., Fitzwilliam, Sip Pond, *Krochmal* 947; Merrimack Co., Warner, *Krochmal*; Hooksett, Lakin's Pond, July 12, 1940, *M. Provost*, and Clay Pond, *Krochmal* 851; Hillsboro Co., New Ipswich, Hoar Pond, *Krochmal* 915; Nashua, Round Pond, June 11, 1946, *Gould*; Rockingham Co., Nottingham, Pea Porridge Pond, *Giguere and Riel* 140, *Riel* 217; Strafford Co., Somersworth, Willand Pond, *Hodgdon, Giguere, Riel et al.* Many of these collections are in excellent fruiting condition; all are otherwise characteristic of this very distinctive pondweed.

The Albany locality (Church Pond) was discovered in 1948 by Martha Gale, then a graduate student at the University of New Hampshire.

Before leaving *P. confervoides*, it is tempting to examine its extraordinary distribution in the light of these many New Hampshire stations. Fernald, loc. cit., pp. 35, 36 concluded that *P. confervoides* and other species of somewhat similar disrupted range occurring in the New Jersey Pine Barrens and also appearing in Northern New England, Newfoundland, etc., in mountainous areas are "really oxylophytes which within rather wide climatic limits are to be expected where highly acid conditions prevail." Further in this same discussion, Fernald suggested that over its entire range embracing Newfoundland, Nova

⁷ A catalogue of the Flowering Plants and Higher Cryptogams found within about thirty miles of Hanover, N. H. 48 (1891).

Scotia, New England, New York, New Jersey, and Pennsylvania, *P. confervoides* tends to inhabit two very different kinds of areas, low-altitude ponds on the one hand and ponds of considerable elevation on the other. Apparently at that time he was willing to explain the occurrence of *P. confervoides* along with other somewhat similarly disrupted species on the basis of their being oxylophytes as noted above. Fernald in the same reference, p. 36, concluded his consideration of this species by stating "From these facts it should be apparent that *Potamogeton confervoides* is to be looked for in the acid region from southern Labrador to the Great Lakes." Earlier, however, Fernald⁸ had suggested that *P. confervoides* was a preglacial relic in the elevated portions of its range and had stated that "If any lowland pondweed were in post-Wisconsin time to do the improbable and invade the elevated mountain-pools from sea-level, it would less unreasonably be a common or, in the region, essentially ubiquitous and less primitive species." With these relatively numerous and widespread New Hampshire stations of *P. confervoides* we are now in a more favorable position than was Prof. Fernald to appraise its distribution objectively. At the suggestion of Dr. S. K. Harris we have obtained altitude records and pH readings for nearly all of the stations.⁹ The following table includes any of the older stations which can be identified with some degree of certainty and all of the recent localities with the exception of a pond in Warner which was recorded only to township when collected. They are arranged in the order of their increasing altitude. The pH readings are those recorded for the pond-surfaces and therefore only partially characterize the plants environment.

It is to be noted that seven stations occur between 100 and 1000, seven others between 1100 and 2000, and two more above 2700 feet elevation. There is no concentration of stations at any particular altitude, either high or low. It must be concluded that the range of *P. confervoides* in New Hampshire is not significantly of either a low- or high-altitude character. Although the acidity-records of the known localities for *P. confervoides* in New Hampshire are somewhat incomplete, it seems likely that all

⁸ RHODORA, 33: 59. (1931).

⁹ The authors are much indebted to Mr. Hilbert Siegler, Senior Biologist, New Hampshire State Fish and Game Department, who very generously has supplied most of the pH and altitude-data for the table from as yet unpublished surveys.

TABLE I

LOCATION, ALTITUDE AND ACIDITY OF NEW HAMPSHIRE STATIONS OF
P. confervoides

<i>Name of Pond</i>	<i>Township or Location</i>	<i>Alt. in ft.</i>	<i>pH</i>
Willand Pond	Somersworth-Dover	184	—
Round Pond	Nashua	180-200	6.0
Pea Porridge Pond	Nottingham	222	5.8
Lakin's Pond	Hooksett	313	6.1
Clay Pond	Hooksett	427	5.5
Sip Pond	Fitzwilliam	884	6.4
Hoar Pond	New Ipswich	962	6.1
Little Cherry Pond	Jefferson	1102	6.0
Church Pond	Albany-Livermore	1220-1240	6.2
Frog Pond	Washington	1610	6.1
North Pond	Washington	1653	5.2
Crawford Lake	Crawford Grant	1771	6.4
Saco Lake (perhaps Crawford Trout Pond)	Nash & Sawyer Location	1891	6.2
Dream Lake	Shelburne	1900	6.2
Lonesome Lake	Lincoln	2750	6.1
Ethan's Pond (? Willey Pond)	Bethlehem	2840	—

stations are definitely acid and some where it particularly abounds, as in Pea Porridge Pond, are strongly acid. The following table lists in vertical columns the percentages of New Hampshire stations for *P. confervoides* in each of several pH ranges as compared with the percentages of reported ponds in the several River-systems of the State, in those same pH ranges.¹⁰ Not by any means are there acidity data for all of the ponds and lakes in New Hampshire in these reports. However, it is hoped that those which have been reported will eventually prove to have been a fairly representative sampling.

Of the 401 ponds and lakes for which we have surface pH data, 280 or nearly 70% are less acid than any of those which have *P. confervoides*, 57 or more than 14% are less acid than all except two of the stations. It seems evident then that this pondweed is characteristic only of acid-waters as was pointed out by Fernald.

If *P. confervoides* is an oxylophyte as seems to be the case and if it is adapted to ponds and lakes at all altitudes between sea-level and 3000 feet, as also seems to be true, it would seem that the species should appear wherever these two conditions occur.

TABLE II
PERCENTAGES OF PONDS IN NEW HAMPSHIRE IN CRITICAL pH
RANGES AS COMPARED TO PERCENTAGES OF *P. confervoides*
STATIONS IN SAME pH RANGES

Watershed	Number of Ponds and Lakes Reported	pH 6.5 or above	pH 6.4	6.2 or 6.3	6.0 or 6.1	Less than 6
Connecticut	108	68.5	12.9	9.25	7.4	1.8
Merrimack	220	74.5	12.7	8.2	.9	3.6
Coastal	17	53	29.4	0	17.6	0
Saco	39	51.25	18	18	10.25	2.55
Androscoggin	17	76.45	17.65	0	5.9	0
Stations of <i>P.</i> <i>confervoides</i> of which acidity is known	14	0	14.28	21.43	42.85	21.43

This does not seem to be true, however, for in New Hampshire, as in Maine and Massachusetts, there is an evident break or discontinuity in the range between the more southern, eastern or coastal stations and the more northern, western or inland stations which usually, but not by any means always, occur at higher elevations. Possible answers to this riddle might be that the intermediate areas have not been adequately botanized or that ecological conditions there are not now suited to the species. After recording and mapping all townships in New Hampshire having acid ponds in which we might most expect to find *P. confervoides* (pH 6.3 to less than 6) we find that such are widely distributed and occur frequently in the intermediate area where *P. confervoides* seems to be absent. Possibly the explanation involves recent geological or climatic history. Continued failure to disclose stations in ecologically suitable intermediate situations might lead one to the tempting hypothesis that the species

¹⁰ (See p. 7) Hoover, Earl E. Biol. Survey, Androscoggin, Saco and Coastal Watersheds, N. H. State Fish and Game Department, Surv. Rept. No. 2, Dec. 1937, and Biol. Survey, Merrimack Watershed, N. H. State Fish and Game Department, Surv. Rept. No. 3, Dec. 1938. Warfel, Herbert. Biol. Survey of the Conn. Watershed, N. H. State Fish and Game Department, Surv. Rept. No. 4, Dec. 1939.

achieved its present disjunct distribution at two quite different times. The more nearly continuous southern, eastern or coastal element conceivably attained its present range more recently than the more isolated northern, western or inland occurrences.

P. ZOSTERIFORMIS Fern.—No records of this species occurring in New Hampshire appear in the literature except an unverified report in Jesup, loc. cit., p. 48. If one studies the map in Fernald's monographic study of 1932, p. 37, the total absence of dots in New Hampshire is startling, particularly in view of the stations that are indicated on all sides. Now this gap can be bridged. The following records show the species not to be common but at least to be widely present in the state: Coos Co., Lancaster, *Krochmal* 1421; Carroll Co., Moultonboro, *Dodge and Sheehan* 579a; Belknap Co., Alton, *Krochmal* 1331 and Alton River, *Krochmal and Gould* 780; Merrimack Co., Boscawen, Walker Pond, *Krochmal* 620; Hillsboro Co., Nashua, Salmon Brook, *Poirier* 282; Sullivan Co., Charlestown, *E. Gould* 24; Cheshire Co., Hinsdale, Conn. River, *Krochmal* 2359.

P. OBTUSIFOLIUS Mertens & Koch—To the already known New Hampshire stations, Lime Pond, Columbia, Coos Co., and Enfield Pond, Enfield, Grafton Co. should be added the following which demonstrate the species to be widely distributed in New Hampshire though apparently not to be expected commonly; Coos Co., Pittsburg, Harris Pond, *Krochmal* 1577; Grafton Co., Littleton, several stations including Mullikan Pond, *Krochmal & Sheehan* 36; Lisbon, Perch Pond, *Krochmal* 1596; Haverhill, *H. Laramie and S. A. Dole*; Carroll Co., Moultonboro, Lake Wakondah, July 23, 1946, *John Dodge*; Rockingham Co., Deerfield, *Krochmal* 1502; Hillsboro Co., Weare, several stations including Peacock Brook, *Krochmal* 853.

P. BERCHTOLDI Fieber, and its varieties—A very large series of specimens has now accumulated including all of the varieties which might have been expected, on the basis of previous reports, to occur in New Hampshire. Var. *polyphyllus* has seemed to be the most rare having been reported previously from but one locality, Ladd Pond, Stewartstown. It continues to be represented the least although it is here reported from Coos Co., Pittsburg; Grafton Co., Haverhill; Belknap Co., Alton; Strafford Co., Durham and Lee; Sullivan Co., Croydon.

P. VASEYI Robbins—While this attractive and delicate pondweed has for some time been known from the Connecticut River or near it in Stewartstown, Hanover, and Lebanon, it may be worth while to add several records to the published list inasmuch as the newer ones are not all from the Connecticut Valley. They are: Coos Co., Lancaster, *Krochmal* 1422; Rockingham Co., Exeter, Exeter Reservoir, *Krochmal and Dodge* 357; Hillsboro Co., Manchester, Pine Island Lake, *Krochmal* 265 (det. by Fernald); Sullivan Co., Cornish, Blow-me-down Pond Aug. 11, 1940, *M. Provost*; Charlestown, Beaver Brook Marsh, *Krochmal*; Cheshire Co., Troy, *Krochmal* 971 (det. by Fernald).

P. PULCHER Tuckerm.—Ogden, loc. cit., p. 121 cites only one collection from New Hampshire and that in Jaffrey in the southwestern part of the state. It seems to be absent from Maine but does appear in southwestern Nova Scotia. A number of New Hampshire stations as follows have been found for it in recent years and all in the southern quarter of the state: Rockingham Co., Nottingham, Pawtuckaway Pd., *Krochmal* 396; Deerfield, Big Shingle Pond, July 15, 1940, *M. Provost*; Merrimack Co., Hooksett, Lakin's Pond, June 8, 1946, *Krochmal*; Hopkinton, Clement Pond, *Krochmal* 743; Dunbarton, Kimball Pond, *Krochmal* 166; Hillsboro Co., Hollis, pot hole, *Krochmal* 300 and No Name Pond, June 13, 1946, *E. Gould*; Peterboro, Contoocook River, *Krochmal* 888.

P. NODOSUS Poiret—Inasmuch as one of the three new records for New Hampshire is remote from the Connecticut River Valley where this species has long been known in Cornish and Hanover, it may be well to list all of the new stations which are as follows: Hillsboro Co., Hudson, Merrimack River, Sept. 10, 1948, *H. Laramie and S. A. Dole*; Sullivan Co., Charlestown, Aug. 7, 1947, *E. Gould*; Cheshire Co., Hinsdale, *Krochmal* 1256.

P. RICHARDSONII (Ar. Benn.) Rydb.—A considerable series of specimens has been taken in New Hampshire all in the Connecticut Valley or nearby and extending all the way from Colebrook to Westmoreland. Its occurrence here is to be expected, for the species, obviously a calcicole, has been reported widely from northern Maine and Quebec, as well as from northern and western Vermont. It has been collected once in Lancaster (Pease) too recently to be included in Ogden's monographic study. The new

records are as follows: Coos Co., Colebrook, Connecticut River, *Krochmal* 1389; Grafton Co., Monroe, Connecticut River, *Krochmal and Sheehan* 62; Lyman, Dodge Pond, *Krochmal and Sheehan* 57 and Ogontz Pond, *Krochmal* 1601; Orford, Upper Baker Pond, *Krochmal* 1467; Sullivan Co., Claremont, Connecticut River, *Hodgdon, Leighton and Richards*, 5885; Charlestown, Connecticut River, Aug. 7, 1947, *Gould and Krochmal*; Cheshire Co., Westmoreland, *Krochmal* 1205. Some of these collections are somewhat intermediate in vegetative character between *P. Richardsonii* and *P. perfoliatus* var. *bupleuroides*. These are the specimens from Colebrook, Dodge Pond in Lyman and Charlestown. We preferred to consider them as extremes of the former.

NOTES ON THE GENUS CAREX I:

A NEW SPECIES OF CAREX FROM WESTERN CANADA ¹

J. A. CALDER

Carex raymondii sp. nov.

C. atratiformis Britton. Bull. Torr. Bot. Club, Vol. 22, p. 222, 1895 (*pro parte, typo excl.*).

Planta caespitosa rhizomatibus brevibus adscendentibus; culmi graciles, 3–7 dm. alt., multo longiores foliis, phyllopodici, summi minute vel valde scabri, acute triangulares; laminae basi foliorum subseptato-nodulosae, planae, marginibus revolutis, glaucovirides, (2.5)–3.5–(6.0) mm. lat., erecto-adscendentes, marginibus ad apicem scabris; vaginae ventrale albae, hyalinae, nonnunquam maculosae, ad summas purpureo-rubrae; ligulae a subquadratis ellipticae; folia inferiora reducta, purpureo-nigra vel pallide subfusco-purpurea; spicae densae 3–4–(7), approximatae, ellipsoideae vel interdum cylindricae, 1.1–2.0 cm. long. × 4.5–8.0 mm. lat., superior gynaeandra (raro foeminea), laterales foemineae vel floribus inferioribus paucis masculis, inferiores paulum arcuatae pedunculis gracilibus scabris vel subglabris, superiores erectiores, pedunculis brevioribus; perigynia (7)–20–30–(50) in spica singula adpresso-adscendentia; bractea inferior foliacea, saepius culmo brevior, vagina brevissima, concolor cum culmo vel basi sparse rubro-purpurea; bracteae superiores subulatae et saepius basi rubro-purpureae; squamae anguste ovatae, acutae vel subacuminatae, 2.5–3.0 mm. long., nonnunquam longiores perigyniis sed saepius breviores, saepius sublucidae, pallide vel atre purpureo-rubrae, marginibus hyalinis obsoletis vel conspicuis, nervo singulo obsoleto vel conspicuo, saepius angusto, pallidiore; perigynia ovoidea vel suborbiculata, paulo inflata, 2.5–3.5 mm. long. × 1.5–2.2 mm. lat., bicostata, enervosa, membranacea, granulosa, puncticulata, pallide castanea vel viridi-castanea, interdum ad summas ± purpurascentia, breviter stipata, rostro 0.4 mm. long., bidentata,

¹ Contribution No. 1190, Division of Botany and Plant Pathology, Science Service, Canada Department of Agriculture, Ottawa, Canada.